

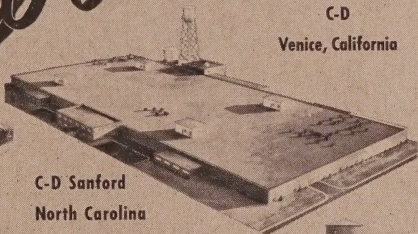
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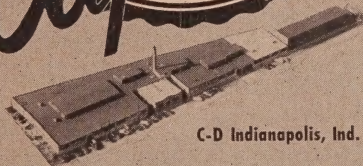
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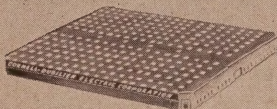
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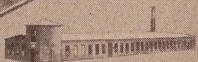
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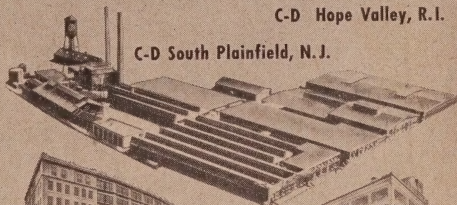
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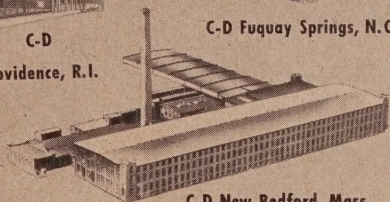
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JAN. - FEB., 1959

ISSUE

No. 1

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TRANSISTOR NETWORK PARAMETERS

Although the transistor is ten years old, there are some points regarding its nature and operation which still confuse many people. One of these points, and perhaps the most important from the number of times it keeps appearing among misunderstood topics, is the matter of transistor network parameters. Except to engineers, and others with equal technical training, these parameters are comprehended the least, of all the material appearing on a transistor data sheet. Because of this, there is a great tendency to ignore and skip over this information, whether it appears in the form of R-parameters or h-parameters.

It is not so much that this material is so hard to understand as that many authors attempting to explain the subject have presupposed more engineering and mathematical preparation than many of their readers possess.

The result has been a thickening of the fog. Certainly this is a disservice, since countless technicians and students who might have made contributions of their own have been driven away from the transistor art by inability to understand important ratings.

The editors have received queries time and again about this subject. The purpose of this article, therefore, is to tell the story in simple language. We know that a clear understanding of the meaning of transistor network parameters will give the "feel" needed by every technician who would apply the transistor successfully to all types of electronic circuits. Not every reader will have had the advantage of a college course in network theory; therefore, we shall temper our language to the situation in attempting an explanation of the basics of the transistor as a network.

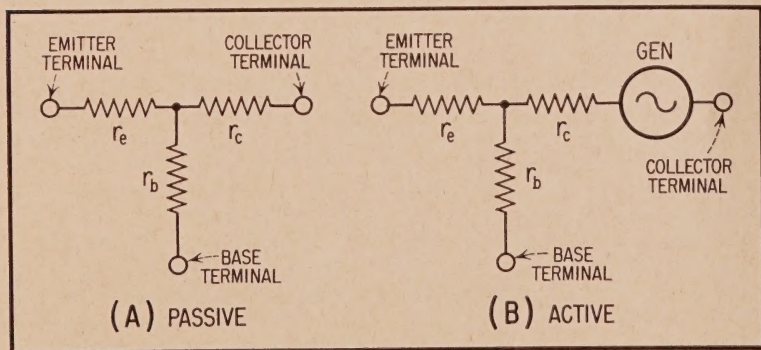


Fig. 1. Equivalent T-Networks of Transistor.

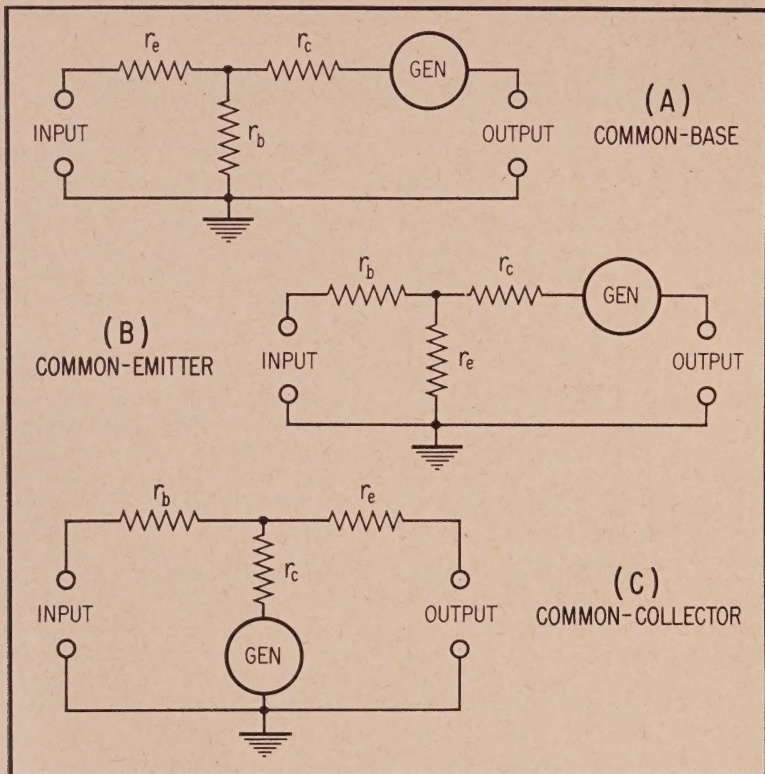


Fig. 2. Equivalent T-Networks of Amplifying Transistors.

Internal Network Nature of Transistor

The transistor is a resistive device: it is a network of resistances. One practical way of representing this component is shown in Figure 1. Here, the internal emitter, base, and collector resistances are shown as they seem to be arranged physically inside the transistor — into a T-network. The emitter resistance is designated r_e , the base resistance r_b , and the collector resistance r_c .

Actually, the arrangement shown in Figure 1 (A) is a passive network. It is the kind of representation you could draw after making d-c ohmmeter measurements on a transistor *if* it were possible to get at the junction point of r_b , r_e , and r_c .

We know that Figure 1 (A) is not a completely true picture of the transistor because we can hook up three resistors in this manner and find very quickly that the resulting T will

not amplify a signal, but a transistor will. The difference is that the transistor is an *active* network. This difference is indicated by the equivalent generator (GEN), a fictitious device, in the collector lead in the active T-network, Figure 1 (B).

The transistor looks like an active resistance network at dc and low frequencies. At high frequencies, it can be described as an impedance network, since it contains internal capacitances, as well as resistances. However, for the immediate purposes of our explanation, we shall stick to the resistance picture. We shall also ignore the fact that a more complicated pi-network of resistors may be employed to represent the transistor.

A transistor is operated in either one of three connections; common-base, common-emitter, or common-collector. Figure 2 shows the equivalent networks of these three configurations for operating transistors.

Since the transistor behaves as an

active resistance or impedance network (Figure 2), its input and output circuits are not isolated from each other but are connected internally. The value of an external load resistance connected to the output terminals therefore must influence the value of the input impedance. So will the resistance of the generator connected to the transistor input terminals influence the value of the output resistance of the network.

It is because of these features that the transistor must be regarded as the network which it is. A successful design must incorporate the transistor (a small network) into the circuit (a large network) in such a way as to provide optimum power transfer, since the transistor basically is a power amplifier. This can be done only when the network parameters of the transistor are known and accounted for.

Transistor as "Black Box"

The triode transistor clearly is a 3-terminal device. However, because

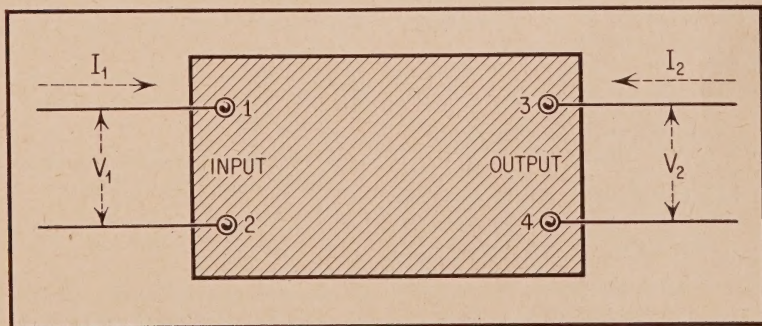


Fig. 3. Equivalent Black Box of Transistor.

of the presence of a pair of input terminals and pair of output terminals, as shown in each configuration in Figure 2, the operating transistor may be regarded as four-terminal in nature whether or not the 4-terminal resistance network (not considered here) is visualized.

For simplicity in working with networks of all types, it is convenient to think of the network as a **black box**; i. e., a box having unknown contents but into which a test signal may be fed, and out of which an output signal may be obtained — often with modifications. Also, aside from the signal-transmission concept, a test signal may be applied to either the input or output of the box and the currents and voltages measured under conditions of open circuit or short circuit of the unused pair of terminals.

Figure 3 illustrates the equivalent black box of the transistor. Here, V_1 is the input voltage, V_2 output voltage, I_1 input current, and I_2 output current. Without knowing what kind of circuit is inside the box, we can determine many of its characteristics by means of measurements from the outside.

Transistor Network Resistance Parameters

Referring to Figure 3, the resistance parameters of the transistor have the following notations and meanings:

$R_{11}=V_1/I_1$ =Input Resistance when output terminals 3, 4 are open; i. e., $I_2=0$.

$R_{12}=V_1/I_2$ =Reverse Transfer Resistance (Feedback Resistance) when input terminals 1, 2 are open; i. e., $I_1=0$.

$R_{21}=V_2/I_1$ =Forward Transfer Resistance when output terminals 3, 4 are open; i. e., $I_2=0$.

R_{22} =Output Resistance when input terminals 1, 2 are open; i. e., $I_1=0$.

Resistances R_{11} and R_{21} are measured with the test voltage V_1 applied to input terminals 1, 2 while resistances R_{12} and R_{22} are measured with the test voltage applied to output terminals 3, 4.

To the mathematician, certain relationships are evident from these important resistive parameters. The loop equations for the transistor network, for example, are: $V_1=R_{11}I_1+R_{12}I_2$, and $V_2=R_{21}I_1+R_{22}I_2$. The mutual resistance r_m of the transistor (the property associated with the active, or amplifying ability of the network) is equal to $R_{21}-R_{12}$. Other relationships are:

- (1) Current Amplification (α)
= R_{21}/R_{22}
- (2) Emitter Resistance r_e (common-base) = $R_{11}-R_{12}$
- (3) Collector Resistance r_c (common-base) = $R_{22}-R_{21}$
- (4) Base Resistance r_b (common-base) = R_{12}
- (5) Equivalent Generator Voltage (GEN in Figures 1B and 2)
= $I_1(R_{21}-R_{12})$

The resistive parameters have a dynamic aspect, as well. For example, in the common-base configuration (Figure 2A) where i_e = emitter current, i_c collector current, v_c collector voltage, and v_e emitter voltage, and where the letter d indicates a shift in a quantity (e. g., $dI = I_2 - I_1$, and dE = corresponding shift $E_2 - E_1$), the following relationships hold: R_{11} is the slope of the curve dV_e/dI_e with i_c constant. R_{12} is the slope of the curve dV_e/dI_c with i_e constant. R_{21} is the slope of the curve dV_c/dI_e with i_c constant. R_{22} is the slope of the curve dV_c/dI_c with i_e constant.

Hybrid or h-Parameters

H-parameters, instead of R-parameters appear on many transistor data sheets. These so-called hybrid parameters are useful for rating the network characteristics of all types of transistors. Two of the h-parameters are measured with the output terminals of the equivalent black box short-circuited, while the terminals are never short-circuited in R-parameter measurement (but are open-circuited). Two h-parameter measurements are made with the input terminals open-circuited.

The hybrid, or h-parameters have the following notations and meanings. Refer to Figure 3 for the current, voltage, and terminal designations:

$$h_{11} = V_1/I_1 \text{ when output terminals 3, 4 are short-circuited; i. e., } V_2 = 0.$$

$$h_{12} = V_1/V_2 \text{ when input terminals 1, 2 are open; i. e., } I_1 = 0.$$

$$h_{21} = I_2/I_1 \text{ when output terminals 3, 4 are short-circuited; i. e., } V_2 = 0.$$

$$h_{22} = I_2/V_2 \text{ when input terminals 1, 2 are open; i. e., } I_1 = 0.$$

R and h Interrelationships

When required, one set of parameters may be obtained in terms of the other set by means of simple calculations. The following examples show how R-parameters may be obtained from h-parameters:

$$R_{11} = (h_{11}h_{22} - h_{12}h_{21})/h_{22}$$

$$R_{12} = h_{12}/h_{22}$$

$$R_{21} = -(h_{21}/h_{22})$$

$$R_{22} = 1/h_{22}$$

$$\text{Alpha} = -h_{21}$$

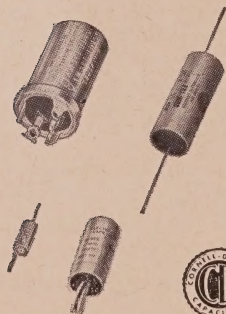
Measurement of Parameters

Transistor data sheets list network parameters, either as R or h values. When this information is not given (and sometimes when it is available but verification is required), the transistor network parameters may be measured.

Practical instructions in measurement of the R-parameters may be found in the article **Simple Methods of Measuring Transistor Impedances**, C-D CAPACITOR, February 1958. The h-parameters may be measured with the same apparatus, provided the d-c output-electrode power is removed where applicable and the output terminals short-circuited during measurement of h_{11} and h_{21} .



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FOR SALE — Heath TC-2 portable tube tester with TV picture tube adaptor and acorn socket, \$45. Michael Bilgri, 146 Hewes St., Brooklyn 11, N. Y.

FOR SALE — BW T/R switch, \$10; coax switch, \$4; WTC CVM I 60 w modulation transformer, \$7; 2 meter 125 w xmitter 90% wired, \$75. K. Miller, 14979 La Cumbre Dr., Pacific Palisades, Calif.

WANTED — Tape recorder Revere, B & H, or Eicore, dual speed. Buy or trade photo, radio test, or machine shop equipment. Polaroid camera and case, \$60. Dewaney Motion Picture, 494 Cline Ave., Mansfield, Ohio.

TRADE — Precision E-400 deluxe sig. gen. for mutual conductance tube tester. K. Barwick, 13569 Piedmont, Detroit 23, Mich.

FOR SALE — Complete 20 meter mobile fone rig: 40 w xmitter, sonar rcvr., power supply, dynamotor, antenna, mike, \$100 complete; 3 element radio specialities 20 meter short beam, \$25. George Bernstein, 2359 128 St., College Pt. 56, New York City.

TRADE — Harvey-Wells 50D and power supply for Millen 90810 and power supply. George Arnold, 126 E. 2nd., Roxana, Ill.

WANTED — Short wave rcvr. National, Hallicrafter, etc., AC only. State lowest cash price delivered. M. Navon, 6210 20th Ave., Brooklyn 14, N. Y.

FOR SALE — Mark II transceiver surplus unit with instruction manual, excellent cond. Make offer. Want RME or equivalent speech clipper. T. K. Brown, 1111 Chenango St., Binghamton, N. Y.

FOR SALE — Recotone Goldring No. 500 SD 1 mil Diamond, 3 mil sapphire, \$15; Pickering 16" transcription arm, \$18. Bruce S. Bialor, 160-24 17th Ave., Whitestone 57, N. Y.

SELL OR TRADE — BC433G 200-1750 Kc compass rcvr, plugs, connectors; need six meter halo or beam, automatic rotator. Julian Sher, 160 Central Ave., Chelsea 50, Mass.

SWAP OR SELL — Hi-fi equipment, broadcast RCA microphones and remote amplifiers, Precision E-200 sig. gen. Want Ampex or Wallensak tape recorder, FM tuners, hi-fi speakers, old xtal set. James Lowe, 1521 Scenic Dr., Pasadena, Calif.

FOR SALE — Gonset Communicator III, series B six meters, less than 3 months old, \$230. Mark Hermann, 2707 Creston Ave, New York 68, N. Y.

WANTED — Millen grid-dip meter 90651; ATR battery eliminator 6-12 v. Quote best price and cond. of equipment. Jule Fantaski, 160 Irwin St., Verona, Pa.

FOR SALE — Eico 315 sig. gen. in perfect working order, \$28; Arkay FM AM tuner in perfect shape, \$26. John McCullen, 3050 Bainbridge Ave., Bronx 67, N. Y.

FOR SALE — Philco 200X UHF converter, \$20; Mallory UHF converter TV101, \$12. Both excellent. Mallory (no case) \$5. Marvin J. Freedman, Inc., Box 98, Buffalo 22, N. Y.

WANTED — Navy RDO rcvr., 38 to 1000 Mc or AN/APR-4, 38 to 4000 Mc; also RDP. Cash or cash plus RAK-8 rcvr., excellent. Sell RAK-8 separately. L. C. Silvern, 1128 Tigertail Rd., Los Angeles 49, Calif.

WANTED — Revere push button tape recorder or Teltape tape recorder; 12 volt battery charger. Eugene Kon, 1516 Broadway, Buffalo 12, N. Y.

FOR SALE — 250 watt all band gross commercially built (1947) AM xmitter. Come and get it \$50. Dave Levine, 3995 Hillman Ave., New York 63, N. Y.

WANTED — MC53 mobile converter for 2, 6, 10-11, meters; also 6 meter xmitter. Merle McCullough, 361 Plainview Ave., Mansfield, Ohio.

SWAP — Hallicrafters S-95 FM rcvr. 152-173 mc for either Hallicrafters S-94 FM rcvr. 30 to 50 mc or Gonset FM tuner 3010-40 to 50 mc. Local only. Joseph Soltis, 21 Liberty St., Passaic, N. J.

FOR SALE — Texas Instruments transistors: two 904's, \$17, and a 903, \$9. Joe Turkal, 1020 Fourth S.W., Massillon, Ohio.

SELL OR TRADE — Hickok 209A VTVM with 30 k probe never used, \$65; 6 w AC amp, \$10. Want McMurdo-Silver Masterpiece V1. John Furey, 807 Reed St., Olean, N. Y.

FOR SALE — Perfect RCA ATJ/CRV59, TV camera in original box, \$99; ATJ/CRV52 TV xmitter in new cond., \$25; DY25/AXT2 dynamotor for above xmitter, \$12; Heath 0-7 scope, hardly used, \$25. All above fob. Bob Schill, Box 412, Hinsdale, N. H.

WANTED — Gonset III, 6 meter in excellent used cond. Robert McNichols, 222 E. 87 St., New York 28, N. Y.

WANTED — Turner TV-2 television booster. John R. Childs, Jr., Box 32, Dahlgren, Va.

SELL OR TRADE — 30 copies each TM for TG-34-A Keyer and TG-7-A, TC-34-A Printer; other miscellaneous copies. Need LM-10 manual and blank LM-10 or later calibration book. H. E. Decker, 1 Queens Court, Huntington 5, W. Va.

FOR SALE — Hallicrafters S-3-8-D rcvr. with Heathkit QF-1 Q multiplier and separate power supply, excellent cond., \$40. James R. Dolvin, 3 Wick-Campbell Rd., Hubbard, Ohio.

FOR SALE — 8 Sam's binders for Photo-facts, \$20 plus shipping. Alfred C. Hart, 207 N. Raymond St., Griffith, Ind.

FOR SALE — Zenith auto radio, good cond., lacks speaker. Make offer. Cordover, 133 Watkins St., Brooklyn, N. Y.

WANTED — Two 1/2 to 1 hp compound wound self excited DC gens. 115 v. max. hp rating 3 hp accepted. To buy or trade for parts. Michael Hanauer, 1544 Steuben St., Utica, N. Y.

FOR SALE — RCA 630, with standard coil tuner, 21" CRT, including cabinet, \$75. You pick up. Chris English, 107-35 129 St., Richmond Hill 19, N. Y.

TRADE — Receiving tubes for transistor radio or S-38 Hallicrafter. G. H. Swiska, 109 E. School St., Woonsocket, R. I.

FOR SALE — Commercial Trades Inst. TV, course, complete with instruments and 21" chassis, \$50 or trade for scope, or what have you? Deam Suby, 816 12 S.E., Mason City, Iowa.

WANTED — B flat clarinet for cash or trade radio gear, service and ham parts. A. Salzwedel, 810 Second St., LaPorte, Ind.

FOR SALE — Heathkit 010 color scope, excellent cond., with low capacity probe and scope demodulator probe, \$65. Randall's Radio & TV, P.O. Bin 52, Hobe Sound, Fla.

WANTED — For cash, RME 69 or 70 communication rcvr., advise cond., and price. Harry Register, 25-94 42nd St., L. I. City 3, N. Y.

WANTED — Copy of ATC manual 52-12 "Guided Missile Fundamentals" or Air Force manual 52-31 same title or information on where available; also used Wollensak tape recorder. Bob Boener, 14716 Fonhill, Hawthorne, Calif.

POSITION WANTED — Laboratory technician, excellent references, graduate Portland Electronics College. First class Radiotelephone. Herbert C. Freeland, 2611 S.W. Glen Haven Rd., Oswego, Ore.

WANTED — Plug in coils for National SW3 rcvr. Trade ARC5 xmitters or rcvrs. or cash. D. Henderson, 176 Winding Way South, Little Silver, N. J.

FOR SALE — Over 80 Sams folders (most below 200) mounted in 7 binders. As one lot for \$60 plus freight. List supplied. S. E. Fellerman, 228 Englewood Ave., Englewood, N. J.

WANTED — Ampex 300 or Magnacord PT63-AH or Concertone 401 tape recorder with proper amplifiers. State price and cond. George Weiss, 220 Park Ave., Punxsutawney, Pa.

SWAP OR SELL — 5" wide range Precision scope, ES-500A, with probe set and instructions, practically new, for good quality SW rcvr. for foreign broadcasts, preferably in radius of 150 mi. A. D. Straughan, Jr., 5015 Indian Lane, College Park, Md.

SELL OR TRADE — Radio and TV components, technical diagrams, magazines and books for 16mm film exposed, silent or with sound. Tom Lemmo, 10 Parkway, Utica, N. Y.

SELL OR TRADE — Tubes and meters, all kinds, PE103, xformers, filter condensers. State your needs. Want Variac and or tape recorder. R. V. Rosellini, 2619 So. Gaylord, Denver 10, Colo.

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FOR SALE — Fisher 500 hi-fi tuner, AM-FM and 30 watt amplifier, \$150; 3 Zenith transoceanic radios, \$15 and up; 2 Crosley Globemasters (2 band), \$25 each. William Wright, 123 Putnam Ave., Freeport, N. Y.

WANTED — Used 630DX or K3C chassis, original transformers and tuner, also Norelco Protelgram high voltage unit 170B. Edward Sargida, 230 N. 11 St., Belleville, Ill.

FOR SALE — Dynamotor 12v-375v-150 mil., \$6; 2 plate transformers, \$6.50-\$7.75; transmitting tubes. H. Southwick, 316 Bank St., Fall River, Mass.

SELL — Overhauled RCA 2-T-51 12" TV, weak pix tube, otherwise perfect, \$20, you pick up; Keystone D-62 16mm movie projector, original carton, \$20 picked up, \$25 shipped in U.S., or trade either for good 22 cal. rifle except single shot. H. Malamud, 122 Eames Pl., Bronx 68, N. Y.

WANTED — Tape recorder, electronic TV course, good VOM tester, 38-S Halli-crafter, hi-fi equip. J. T. Wentworth, 4269 Packingham Dr., Mobile, Ala.

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WANTED — Circuit diagram or technical information or address of manufacturer of Eastern Amplifier type 600 AM transmitter. John London, 2235 Fifth Ave., New York 37, N. Y.

SELL OR SWAP — Back issues QST, Radio-TV News, 12 v DC gas gen., ship-to-shore radiophone, misc. electronics parts. R. H. Ives, R2-B32, Lynnhaven, Va.

FOR SALE — Hickok 610 TV sweep alignment gen., clean, working cond. Complete with manual, set marker xtals, cables, \$45 fob. Henry Pasier, 5000 N. Natchez, Chicago, Ill.

FOR SALE — ARC 5, 75 m, xmitter and rcvr.; i.v. power supply; modulator p.p. 1625's class AB-1 and power supply; Eimac dynamotor 6v in, 400 v @ 375 ma out. D. Dispenza, 550 Ft. Wash. Ave., New York 33, N. Y.

WANTED — Ballantine 300 series VTVM. State calib. date and price. Cash or trade. C. Osiecki, 3165 36 St., Long Island City 6, N. Y.

FOR SALE — National rcvr., NC-98, 1 n., \$75. H. R. Schielke, 1074 Wildwood Rd., Oradell, N. J.

FOR SALE — NRI electronic multimeter, no AC head, \$8; RCP multimeter 447B, \$8; 19AP4 picture tube, \$5. All in good cond. B. Zaino, Woodlawn P.O. Sta., New York 70, N. Y.

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FOR SALE — Jackson CRO-2 scope, \$100; VM 700 tape recorder with ten tapes, \$110; Sylvania 134Z VTVM, \$25. All in excellent cond. Thomas Dunn, Old Blue Pt. Rd., West Scarborough, Me.

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FOR SALE — Rubicon portable Wheatstone Bridge, model 1050 with leather carrying case, practically new, \$75. J. Leonard Herron, 6340 Magnolia Ave., Chicago 40, Ill.

WANTED — TS-488/U, AN-UPM-11, TS-147D, other military test sets; also R-278/GR, T-216, T-217/GR rcvrs. and xmitters. D. E. Cimino, 2246 Betty Lane, Beverly Hills, Calif.

WANTED — Instruction manual for solar model CE capacitor analyzer. State price. I. A. Rouce, 724 Locust St., Jefferson City, Mo.

FOR SALE — Presto SR11 tape recording console 7 1/2 or 15" per second, complete with VU meter, excellent cond., cost \$1,600 — for \$600 fob. H. Walker, 564 Dawson Ave., Town of Mount Royal, Montreal, Quebec.

FOR SALE — RCA senior voltohmmyst WV-97A, \$59.50; Sprague Tel-ohmike TO-3, \$39.50; both instruments good as new. E. D. Rogers, 308 Grata Rd., Knoxville 14, Tenn.

FOR SALE — Rare old Edison Amberola phonograph, with about 60 cylinder records, good cond., \$45 fob. M. E. West, Rt. 2, Lenoir, N. C.

TRADE OR SELL — Riders radio manuals, 6, 8, 10, 12 to 15; RCA manuals Vol. 1 and 2; Sams folders 1 to 41; Motorola FMT50B, 50W NBFM xmitter with power supply, 117 v., instruction manual; Jackson condenser tester, 650A. Best offer takes any or all. D. Neubauer, 8604 Fayette St., Philadelphia 50, Pa.

FOR SALE — Millen 90903 scope and 90201 scope-amplifier and sweep unit, excellent cond., instruction books included. Best offer, cash and carry. T. F. Benewicz, 3050 Edwin Ave., Fort Lee, N. J.

FOR SALE — Globe Scout 65A xmitter, 65 w fone-CW factory-wired, band-switching 160 thru 10 meters, Shure reluctance mike, Lear antenna relay, coax fittings, assorted xtals. and instruction manual, \$65. F. McCabe, 2318 Terrace Rd., Hypoluxo, Fla.

WANTED TO BUY — TV repair course without kits. State price. Norman E. Gibat, 5 South Main St., Cape May Courthouse, N. J.

FOR SALE — Supreme 589 tube tester, nice cond., \$35. Robert Cabaugh, 29-22 213 St., Bayside 60, N. Y.

FOR SALE — Jackson 648 fil. transf., \$5; Philco 6100 vacuum tube voltmeter, \$40; Eico 1050 battery eliminator, \$27.50. Test leads included on both instr. Pay pp and ins. G. W. Echement, 1911 Coachman Rd., Clearwater, Fla.

WANTED — Isolation transformer, Heath or similar. Cash or trade. Write specifications and desires. Raymond Downs, 51-01 39 Ave., Long Island City 4, N. Y.

FOR SALE — Temco 75 GA xmitter, 130 w on AM, 150 w on CW, band-switching 80 thru 10 meters, VFO, copper screened for TVI. May need some repair. What am I offered? Local buyer only. Ruth B. Siegelman, 2336 Holland Ave., Bronx 67, N. Y.

WANTED — BC923 rcvr., surplus test equip. Will rent or buy manual for 1E19. W. E. Lettsome, 2502 20 St., Racine, Wis.

FOR SALE — Solid run of all issues of QST from 1937 to 1948, in excellent cond. Sold to highest bidder. Need QST's before 1923. Alan York, 35 Main St., East Hampton, N. Y.

FOR SALE — Electro-Voice 636 microphone, \$25; Precision deluxe 10-54 tube tester, built in ohm-volt meter, \$95; University 308 speaker, \$20; xtal mike, \$1. All l. n., shipped cod. Johnny, 85-61 66 Rd., Forest Hills 74, N. Y.

WANTED — Small radio preferably with clock. Have fine man or woman's wrist watch. Levriett, 816 Broxton, Jacksonville, Fla.

WANTED — 1957 Amateur Handbook; Webcor 210 tape recorder; Eico 360 sweep gen. kit (1955); Silver 903 wave-meter, less coils, with original tuning capacitor. Richard Parker, 1018 S. 24 St., Philadelphia 46, Pa.

RARE ANTIQUE — Amrad 1/4 hp 115 v AC motor, runs l. n., designed by Vanevar Bush in early 20's. Best offer. Frank Pray, 1156 Commonwealth, Boston 34, Mass.

FOR SALE — Eicor 15 and sound mirror BK-401 half track tape recorders; 1 xtal and 1 magnetic mike; Timex recorder and Amplifier Corp. tape deck, \$140 complete. Thomas McCain, 415 Shook Ave., Stroudsburg, Pa.

WANTED — Higgins camping trailer, any cond., for cash or swap TV test equip.; radio-TV correspondence course; TV sets; hi-fi equip.; or pre-recorded stereotapes. L. H. Wilson, 626 N.W. 27 Ave., Miami 35, Fla.

FOR SALE — Bench drill press, \$12; Rider's Troubleshooting 1-16 incl., good cond., \$90 plus express; RCA Jr. VD meter probe and instructions, \$25. G. T. Mackenzie, USA Ret., 7130 SW 92 St., Kendall 56, Fla.

WANTED — Watt-meter in good operating cond., cheap. Wallace Fauke, 1350 Fairfax St., Carlyle, Ill.

SELL OR TRADE — Radiola III type R-1; Atwater Kent, models 35, 40, 42; Amrad neotrodyne revr.; old spkrs. Send for list. Jim Ladely, Box 443, So. Tacoma, Wash.

POSITION WANTED — Sales, outside, by ass't dept. manager with excellent background in electronics. Age 42, married, radio amateur, jobber, publishing background. R. Wasserman, 150-48 75 Ave., Flushing 67, N. Y.

FOR SALE — All like new Precision test instruments: E-200C, 98MCP, 10-54P, latest deluxe instruction books. Cas, 8561 66 Rd., Forest Hills 74, L. I., N. Y.

FOR SALE — Crown Imperial 3-speeds, 20 w output, tape recorder, \$375; Presto Pirouette T-18 12' turntable, \$50. Both l. n. Vic Lapish, 766 Elmwood Ave., Jackson, Mich.

FOR SALE — Like new BC610C with complete set of spare tubes, antenna tuner and on casters, \$325 fob. Mike Barlow, 2827 Whitehall Rd., Muskegon, Mich.

TRADE — American photocopy machine and accessories for test equip., tubes, radios, recorders, battery charger. G. E. Bartlett, Box 134, Atlanta, Mo.

FOR SALE — Rider's TV manuals 1 to 10, \$75 or best offer. Excellent cond. Local only. G. J. Krauss, 44 Valley Stream St., Box 632, Islip Terr., L. I., N. Y.

WANTED — Tech manual and/or any other information on the Navy RT/19 ARC4. Name price wanted. Norman F. White, R 1, Londonberry, N. H.

HELP — Need op. manual Heath gen. TS-1A, will buy or pay to copy. Sell or trade Feiler wireless int. com., brush disc rec. guns and photo equip. Ray H. Mayer, 4336 W. Maypole Ave., Chicago 24, Ill.

FOR SALE — Heathkit LP1 modified to LP2 linearity pattern gen., l. n., \$20. R. F. DeHaan, 2305 E. Hammard Lake Dr., Pontiac, Mich.

FOR SALE — 24 Holtzer-Cabot, 9 Kollman and 9 Bodine cap. induct., slow speed, high torque motors; 22 extra gear trains; 10 AC motor capacitors; 11 extra rotors; 9 extra fields and housings. All 115 v, 60 cy, \$50 fob. G. Kusse, 3137 Cleveland Ave., Michigan City, Ind.

WANTED — 7JP4 pix tube in good cond. J. I. Lacey, 145 62 St., Niagara Falls, N. Y.

WANTED — Motorola console radio with clock, 1943 model 101c31 or similar, need not be in working condition. Don Eppard, 1509 8 Ave. N.E., Rochester, Minn.

SELL OR SWAP — Like new 67 copies QST from 1951 to 1957; 1945, 1953 Handbook, various copies of CQ, Radio & TV News. S. Dubov, 3100 Brighton 2nd St., Brooklyn 35, N. Y.

WANTED — Good used copy Riders "Oscilloscope at Work," must be reasonable. Daniel McCarthy, 32 Chatham St., Hartford, Conn.

FOR SALE — 3 element Elinco 10 meter beam, good cond. except needs new bolts and nuts, with instructions, \$15; 50 ft. RG/AU for above, \$3; Regency and Sutton TV boosters, \$5. Byron Wise, 1902 N. Monroe, Decatur, Ill.

WANTED — Circuit diagram for Magnavox RCV-2 (Navy) rcvr. Charles Leigh, 10 So. Lanning Ave., Hopewell, N. J.

FOR SALE — Ampex 600 tape recorder, 1 n. William Sahakian, 27 Great Road, Bedford, Mass.

SELL OR TRADE — Complete darkroom equip. in good cond.: 4 x 5 enlarger, printer, drier, blower, etc. Want 15 to 20 w. hi-fi amplifier with pre-amp. H. Seidman, 1425 Linden Blvd. 3C, Brooklyn, N. Y.

FOR SALE — RCA audio chanalyst with accessories, instruction book, \$50; Halli-crafter S38 SW rcvr., \$25; Brush sound mirror tape recorder 401, needs repair, \$45. S. Kazanoff, 82-15 Little Neck Pkwy., Floral Park, N. Y.

FOR SALE — Lysco 600 xmitter, TVI'd, clean cond., operates perfectly, with model 50 antenna coupler, \$50 for both. L. M. McGee, 501 E. Wyatt, Herington, Kan.

TRADE — Electronic and electrical technical books, test equip. or cash, for U.S. or foreign stamps, old or new. Will exchange lists. A. N. Giddis, 145 Bellevue St., Lowell, Mass.

WANTED — Hickok 770 scope and 695 sweep gen.; also Sam's binders without Photofacts. Fenton Canfield, 86 Hampden Rd., Rochester 10, N. Y.

FOR SALE — Unused U-Check-Em self-service tube tester floor model with tube storage cabinet, \$75 plus shipping. G. N. Buffington, 544 S. 24 St., Harrisburg, Pa.

FOR SALE — Heathkit 0-11 scope, with low capacity and demodulator probes, recently assembled and remodeled for much greater sensitivity, intensity, and vertical sync stability by radio engineer. Warranty incl., \$100 or best offer. Irv's Electric Shop, Ingalls, Kan.

FOR SALE — Heath VF-1 VFO, \$15; Zenith 2328R 16" TV, \$60; Wilcox-Gay deluxe 5F 8 w tape recorder, \$100; Tel-Tape portable transistor battery tape recorder, \$25. All in perfect cond. Best offer. Howard Fine, 67-19 172 St., Flushing 65, N. Y.

FOR SALE — 18" Jesnen "super" woofer; 5820 Image Orthicon. Dave Oxman, 2202 W. Whitton Ave., Phoenix, Ariz.

FOR SALE — Precision 954-G electro-namic tube and set tester, perfect cond., doesn't measure AC volts, instructions, \$60 plus shipping. Frederick R. Shutt, 612 Frantz Ave., Mullens, W. Va.

FOR SALE — RCA color TV Pict-O-Guide, \$4.50; McMurdo-Silver 903 wavemeter with coils for 40-20-10 mtrs., \$5; Master 232XSSC, mobile mount, \$10. All pp. S. Egelberg, 3029 Matthews Ave., Bronx 67, N. Y.

SELL OR TRADE — Regency DB250 sig. booster, FM Pilot tuner, Webster-Chicago record player 8 years old automatic 2 speed, \$25 or swap for good audio amplifier or TV UHF converter. Corbert Adams, 3518 Stanton, Springfield, Ill.

TRADE — Tape recorder, 1 n., Brush BK 416 sound mirror, perfect cond. for good make sweep gen. Mike Cory, 4164 Harrison St., Bellaire, Ohio.

WANTED — RCA KRK 9 tuner, cash or trade. Have 71P4 pix tubes, test equip., books. Troch, 290 Main St., Spotswood, N. J.

SELL OR TRADE — 8" tilt arbor circular saw with metal table with extensions, rip fence and guide, 1/2" hp motor, very good cond. Cash or trade for hi-fi equip. Joseph Grandolfo, 4188 E. Tremont Ave., New York 65, N. Y.

FOR SALE — Two perfect BC645 transceivers, \$45; 6 v alternator, rect. and reg., \$45; 6 v 450 v Carter dynamotor, \$18. T. J. Sulas, 5808-80 St., Elmhurst, N. Y.

WANTED — Recent Gonset communicator, 2-meters, 12 volts, in perfect cond. Write full details. J. Abramowitz, 20 Bowler Rd., Lynbrook, N. Y.

SELL OR SWAP — RCA Pict-O-Guides Vol. 1-3, perfect. Need Alliance rotator type HIR or U98. Harry M. Boone, 200 Brightside Ave., Pikesville 8, Md.

WANTED — Heathkit W4-AM for 20 w amplifier. Cash or Heathkit WA-P2 pre-amp and cash. Ray Langlois, 11360 Segrell Way, Culver City, Calif.

WANTED — 1/2 electric drill. Have Craftsman 6" electric saw in perfect cond. C. B. Kolley, 7204 Cloverbrook Ave., Cincinnati 31, Ohio.

WANTED — 150 to 200 w xmitter with power supply. Prefer DX-100; Heath Q multiplier. Will consider good home brew. Have complete sound systems from 40 to 75 w o.p. Test equipment and cash. John Arnold, Wilson St., Bluffs 3, Ill.

WANTED — 1925 or earlier battery radios, xtal sets, Radiolas, Atwater Kent, Paul Thompson, 1300 So. Main St., Las Vegas, Nev.

WANTED — Old test equip., i.e., Jewell 199, 444; Supreme 400-B dynameter; Weston 565, 566, 660, 663, 665, etc.; or Simpson Roto-Ranger. State condition. Satullo, 4512 N. Woodward, Royal Oak, Mich.

WANTED — Color TV set or color pix tube in any cond.; 19VP22 CBS and 21AXP22 RCA color pix tubes for cash. Murray Sinuk, 1600 Steward 425, Detroit 6, Mich.

SWAP OR SELL — TV tuners, hi-vol. trans., b'cast var. condensers, phono or recorder parts, Philco old band FM SW and rad. chassis for ? F. Cabon, 5734 Waring, Hollywood 38, Calif.

TRADE — Hallicrafters SX-100 communications rcvr. with matching speaker, excellent cond., for U.S. mint stamps or first day covers. Bernard Arkenau, 23 Berwyn St., East Orange, N. J.

WANTED — Service manual for National NC 101X. Raymond Dodge, 676 Verde Vista Ave., Pomona, Calif.

FOR SALE — F.C.C. correspondence course 1, 2, and 3 class (Grantham Schools) license, \$35. W. R. Titmus, 1854 E. Ave., Q-11, Palmdale, Calif.

SWAP — 1 set German made quality drawing instruments, genuine chrome plated, excellent condition. Swap for Heath instrument. H. Pillar, 242-12 Horace Harding, Douglaston, Queens, N. Y.

SELL OR TRADE — RA10-FB direction finding rcvr., BC-AO-230 xmitter, A61-A dummy antennas with 4 amp RF meter, 100 mmfd. vacuum condenser, power supply chokes and condensers. Want latest edition "Editors & Engineers Radio Handbook." Ed Block, R 4, Grandview, Tex.

FOR SALE — Zenith Royal transistor hearing aid, excellent cond., \$15 plus postage; HQ100 rcvr. practically new, \$140 plus shipping. Mike Yacenic, 105 Elm Drive, Trafford, Pa.

FOR SALE — UHF factory tuner to fit all Philco TV 90 using RF chassis 91 or 94. Installation instructions inc., \$15. J. Bolme, 405 S. 41st, Boulder, Colo.

FOR SALE — C-D Powercon vibrator converter, model 110 T22, input 110 DC, output 110 AC, local only, make offer. Isidore Olesh, 845 Schenck Ave., Brooklyn 7, N. Y.

SELL OR TRADE — Hickok 203 VTVM; Solar CBB capacitor checker; BC 458, BC 453; Riders Radio 6-14; Sams Photofacts 1-126, all A-1 for latest Heath or Paco scope, VTVM, sig. tracer, B & K CRT tester. Don Jensen, 3529 Dunn Ave., Cheyenne, Wyo.

FOR SALE — Sylvania 451MQ color TV, mirror finish cabinet, 1. n., \$175; RCA WR36A dot-bar-white dot generator with RF and video outputs, 1. n., \$95. Walter Raucher, 3819 W. 82 Pl., Chicago 29, Ill.

TRADE — Complete National Radio correspondence course; also mandolin, excellent cond. What have you? Nat Breselor, 88 Union Ave., Clifton, N. J.

FOR SALE — Lettine 240, excellent cond., with coils: 10, 20, 40, 80 meters, \$50; Heath AR-2 rcvr., \$20; S-40-A rcvr., with "S" meter, excellent, \$75. All above fob or will deliver 100 miles. Morris Feigenbaum, 21 Boothbay St., Hartford 12, Conn.

WANTED — 12A7 tube in perfect cond. Lawrence Cerqua, 3 Hayward St., E. Orange, N. J.

WANTED — To buy, rent, or borrow instruction manual for Heathkit communication rcvr. AR-2. Ray Suoboda, 3747 Home Ave., Berwyn, Ill.

WANTED — Manual for Supreme 560A vedolyzer and Supreme 561 sig. gen. Advise price. Roy Humphreys, Ballard, W. Va.

WANTED — For cash, McMurdo-Silver 700 xmitter and 800 rcvr., for 2 and 1 1/4 meters. M. J. Thornhill, Hoschton, Ga.

WANTED — Sams Photofacts, state cond. and price delivered to Boston area. Prefer local. L. Berkowitz, 10 Kilsyth Rd., Brookline 46, Mass.

AVAILABLE — E.I.Co loose coupler 1910. Need 6 and 12 volt "A" supply. Charles Radio Service, 81 Warren St., Roxbury 19, Mass.

FOR SALE — S38 Hallicrafter rcvr., excellent cond., \$20; 4 Chev. radios 1948 to 1951, good cond., \$10 each. Andy Mihok, Old Bridge, R 1, Box 11, N. J.

FOR SALE — Perfect Knight kit tube tester wired and tested, \$35; Ohmite 10,000 ohm, 5 w wire wound resistors, 10c each. James Fred, Box 54, Russia-ville, Ind.

FOR SALE — Eico 625 tube checker, Sprayberry TV chassis with 7" tube, Philco 7EP4 tube, Sprayberry 6 tube superheterodyne chassis, seven power TV transformers. William Heilbrand, 782 So. 19 St., Newark 3, N. J.

TRADE — 7½ Craftsman saw with case; Zenith H-500 transoceanic, 1. n.; Shure CB50 mike push to talk, 4-125 tube. Need ham gear, DX-100 or ? E. De-Cobert, Jr., 609 Henrietta St., Gillespie, Ill.

WANTED — TCS-12 rcvr., vertical mounting brackets and AC power supply, rectifier type 20218, 60 cycle, 110 v AC, also 12 v DC power supplies. Floyd Rondeau, 2436 Carney Ave., Maunette, Wis.

FOR SALE — Used TV sets, 10, 12, 17, and 21", all in good cond. A.C.A. Television, 1111 E. Elizabeth Ave., Linden, N. J.

SWAP — Geiger counter probe type, and Uniflex 11 camera, for condenser checker. G. E. Stowers, 2020 East 48 Terr., Kansas City, Mo.

FOR SALE — Tube tester; sig. gen.; empty 16mm 100 ft. spools; portable radio; Todd check writer; movie film. Cascio, 8561 66 Rd., Forest Hills 74, N. Y.

WANTED — Issues of Modern Electrics; Electrical Experimenter; Radio News (before 1929); Television News (1931-33); Television (English, before 1940); Fernsehen (German, before 1940). E. K. Everett, 1206 N. Prospect St., Tacoma, Wash.

FOR SALE — Unused GE hook-on volt-ammeter (AK-1) with instructions and leather case, 0-15/60/150/600 amps, 0-150-600 volts, \$55. F. E. Courtney, 5915 Greene St., Philadelphia 44, Pa.

FOR SALE — BC-348 rcvr., 115 VAC, noise limiter, S meter, loudspeaker vol., \$65; 2C40 Lighthouse tubes, 1. n., \$3; PE-101-C dynamometers in sealed cartons, \$5. L. Seigle, 2 Wenonah Ave., Rock-away, N. J.

FOR SALE — GEG-5101-D 6 v 40a-shunt gen., external voltage regulated and current control. Used on surplus Army jeep, \$10 fob. W. F. Hopkins, 475 Lincoln Ave., Wyckoff, N. J.

WANTED — Remote control unit for Bell 2145 hi-fi amplifier. Walter Hawthorne, 31 Hamilton St., N.W., Washington 11, D. C.

FOR SALE — Ampex 600, ½ track, factory-modified edit feature, \$360; Ampex 620, \$90. Both 1. n. in brown Samsonite; Hickok 209A VTVM with HV probe, 1.n., \$75. Clay Allen, 40 Avalon Rd., Garden City, L. I., N. Y.

WANTED — Part No. 48-017 3-gang tuning and bandsread condenser assembly for SX16-H50676 Super Skyriider rcvr. State price and cond. John Zoltek, 134 Elmwood Pl., Wyckoff, N. J.

WANTED — NRI Professional TV Servicing course or Sprayberry Advanced TV Servicing course, with or without kits. C. W. Hume, 221 S. Bon Air, Youngstown 9, Ohio.

SELL OR TRADE — Heath 12 w amplifier with preamp EA-2. Sell for kit price or trade for 12" low frequency woofer speaker. John Kimm, 934 Judson St., Evansville 13, Ind.

SWAP — Model 70, 30.06 Winchester big game rifle with K 2.5 scope mounted and case for the works for late model communications rcvr. Gerald O. Laxson, M.D., U.S. Vet. Hosp., Sheridan, Wyo.

FOR SALE — Paco V70 VTVM, \$28; Zenith L600 transoceanic, \$70; \$75 Emerson 855 transistor portable, \$35; Simpson 555 tube tester, \$35; late Raytheon 17" portable TV, \$40. Want 3" Heath-scope. Chester Benson, 333 So. 5th, Richmond, Ind.

FOR SALE — Eico 315K sig. gen., good cond., accurately calibrated, \$26. D. Pollock, 178 Pinckney Rd., Little Silver, N. J.

FOR SALE — RCA UHF sig. gen., 370-560 mc, \$60; RME DB-22 pre-selector, \$25; Motorola FM xmitter with 2-meter ham xtal, \$25; RG-22/U, 100' coil, \$5. G. H. Goldstone, 25416 Parkwood, Huntington Woods, Mich.

BARGAIN — Two Pickett metal slide rules with log to log scales, dual base, plastic case, instruction books, leather carrying case, \$17.50. Don Herrick, Valparaiso Tech. Institute, Valparaiso, Ind.

WANTED — All-wave rcvr. similar to Hallcrafters S X-62A. State cond. and price. Charles McDonald, 4492 Gratiot Ave., Port Huron, Mich.

WANTED — Collins military communications rcvrs. such as R388, R390, 50E6, 51J, etc. Will pay top price. Herbert Gordon, Harvard, Mass.

WANTED — VOM, home built or commercial, in good cond. John Davis, 6801 19th Ave., Brooklyn 4, N. Y.

FOR SALE — Pickering 260DD dual diamond cartridge, \$25; GE dual diamond Cartridge, \$15. Both like new. Myron Bobbe, 160-38 17th Ave., White-stone 57, N. Y.

FOR SALE — 400 w 813 rig, all bands, pi-net output includes: 6" rack, VFO, phone patch and phone, CR 811 monitor, 866 pwr. supplies, mike, 7 meters, 3 variacs, coax relay, \$200. Mrs. J. Zawediuk, 1613 Woodbine St., Bethlehem, Pa.

FOR SALE — PE75 portable gen., 3000 w, 110 VAC, powered by 7½ hp B & S engine, \$220. R. Dombrowski, 3724 N. Cicero Ave., Chicago, Ill.

FOR SALE — NRI 69 tube tester with instructions, \$20 plus express collect. Alexander Courtney, Box 1701, West Palm Beach, Fla.

WANTED — Command Set — broadcast band (550-1500 kc) rcvr. with or without dynamotor. Advise price and cond. A. L. Oliveira, 94 Potomska St., New Bedford, Mass.

WANTED — Collins 310-B exciter or similar unit in good cond., for cash, ham gear. Pfc. Murray Cohen, 8th Signal Detachment, Ft. Geo. G. Meade, Md.

FOR SALE — Mobile air conditioner on wheels, 1 ton capacity, water cooled, 28" high x 18" wide x 17" deep, 110 volts, excellent cond., \$200. Tompkins Sq. Radio Co., 117 East 7 St., New York 9, N. Y.

FOR SALE — Unused tubes, list approx. \$350, \$75 for lot; Riders Vols. 4-22. Make offer for one or all; Coyne 5-Vol. R & TV library, with diagrams book, \$8. J. O. Basham, 214 Craig St., Covington, Va.

WANTED — Four 304-TH or 304-TL tubes. State price. D. Phillips, 49 E. Grandview Ave., Sellersville, Pa.

POSITION WANTED — As research technician or technical writer: graduate Portland Electronic College, 1st class radiotelephone license, 2 years writing and 10 years supervisory administrative experience. Herbert Freeland, 2611 S.W. Glen Haven Rd., Oswego, Ore.

SELL OR TRADE — 2 elapsed time meters, 120 VAC 3", \$10 each; DC voltmeter 0-100 v 2½" mount, \$5; AC meter 0-300 v, 3", \$7; DC voltmeter 2, scales 0-15, 0-600 2½" mount, \$7, 0-1 DC ma meter, 3", \$7. All meters l. n. Trade for test equipment. C. Kosinski, 1638 Westchester Blvd., Westchester, Ill.

FOR SALE OR TRADE — Harvey-Wells bandmaster senior TBS 50D with power supply and antenna relay, \$50 or trade. C. Johnson, Box 252, Newfoundland, N. J.

SELL OR TRADE — Sprague KT-1 capacitor tester, \$20; flyback yoke tester, \$15; Jap rifle 31 cal., \$30. Want Gonet 3009-6 FM converter or similar. Don Engel, 3201 Janet Rd., Silver Spring, Md.

FOR SALE — Slightly used Sprague Tel-Ohmike TO-4, l. n., instruction manual, \$60 express collect. H. V. Sulfridge, 2133 Norvell Dr., Knoxville 18, Tenn.

FOR SALE — Zenith FM-AM model H 723 like new, only \$55; Monitoradio MR-33, 30-50 mc, tunable FM rcvr., \$61. Both fob. G. D. Griffin, 322 W. State St., Ithaca, N. Y.

FOR SALE — Heath Q-multiplier, \$7; Mallory UHF converter TV101, \$8; GE voltage stabilizer, 30 w, 115 VAC, \$5; Sams Photofacts, 10 folders, 60-192, plus PF Reporter, 22 copies, '53-'58, all for \$8, plus postage. Dick Rogers, 28 Bellamy St., Brighton 35, Mass.

SELL — Used 25 to 42 mc FM mobile xmitters complete with tubes and dynamotor, \$7 each. Easy to convert to AM or 12 volts; also FM rcvr. for same frequency, \$27.50. Ralph Villers, LB-1, Steubenville, Ohio.

FOR SALE — Unused Jensen P15-LL 15" woofer in original carton, \$35; Knight VTVM assembled, l. n., \$20; Fairchild 280A transcription arm with Fairchild (Fisher) cartridge, diamond .001, \$35. J. Leonard Herron, 6340 North Magnolia Ave., Chicago 40, Ill.

FOR SALE — Heath AT-1 xmitter, \$25, or best offer. Prefer local. Al Goldsmith, 77 Wetherbee Rd., Waltham 54, Mass.

FOR SALE — Antique radios: Neutrodyne, Erla, Stewart-Warner; Old Freshman AC job; Radiola III with 2 tube amp; Radiola 60 w 103 spkr.; homemade Cockaday regen sets; Federal Telephone speaker. Want factory built side-swiper key. Jack Nelson, 915 Sherman St., Schenectady 3, N. Y.

FOR SALE — Like new 3½" Weston 301 meter, 0-500 VDC, 1000 ohms per volt, \$8 postpaid. L. Cohen, 151-09 34th Ave., Flushing 54, N. Y.

FOR SALE — Riders Vols. 4-9, in good cond., \$25. F. L. Burgess, R. 2, Gales Ferry, Conn.

TRADE — BC-221-AK frequency meter with modulation, factory commercial AC power supply, and original calibration book, for DX-100, Gonset 2 meter 6v/100v communicator or unconverted ART-13 with manuals and dynamotor supply. J. E. Struthers, Morrisonville, N. Y.

WANTED — All copies of Sams PF Reporter older than Jan. 1955, in any cond. Francis L. Schiel, 615 Glenwood St., Waterloo, Iowa.

FOR SALE — One HT-1 Hallicrafter, very reasonable. William Tate, 4632 Chesapeake St., N.W., Washington 16, D. C.

FOR SALE — Meissner 150B xmitter, little used. Spares nearly complete, includes VFO. Best offer or first \$225 check. K. H. Wycoff, Overton, Neb.

FOR SALE — Ant tuner 400 w B & W plug-in coils and link, 2 GE 0-4 RF thermocouple meters, 2 Johnson 20-140 mmfd. cond. parts, prepaid \$30; B & W balun unit, \$6; Viking Valiant factory wired; HQ150 rcvr. and spkr. H. E. Leigh, Sr., 828 Nevada Ave., San Jose 25, Calif.

FOR SALE — Bud CR1744 cabinet; Stan-cor 414 amplifier; ART-13 modulation, driver, filament transformer; Hammarlund speaker; National SCN dial; Components for 0-2000 volt at 250 ma power supply. Want .22 pistol, binoculars, spinning reel. Joseph Nester, 509 E. Alle Ave., Emporium, Pa.

SELL OR TRADE — All items in good condition: transmitting tubes, transformers, generators, prop pitch motor, wire recorder condensers, command rcvrs., xmitters, etc. Write for list. T. C. Fratic, Paxton, Ill.

FOR SALE — GE ¼hp single phase 110-220 v, 60 cycle motor, \$12; Clough-Brengle 127 scope and modulator, \$25. Paul Capito, 637 W. 21 St., Erie, Pa.

TRADE — 750 TL xmitting tube and photo enlarger for good communications rcvr. Richard H. Johnson, 2299 Bluefield, Hayward, Calif.

SELL OR TRADE — Hallicrafters S40-A communications rcvr, Howard 436 communications rcvr. Both in good working cond. Want test equip., especially late model tube tester. New York City vicinity only. Max Reiter, 2531 E. 19 St., Brooklyn 35, N. Y.

SELL OR TRADE — 2 BC375E xmitters, BCAR430 xmitter, Alliance automatic door opener, rotators, boosters, dynamos, tubes: 304TL, VT119, 211, 872, etc. Richard Grant, 3863 Government St., Baton Rouge, La.

SELL OR TRADE — Tubes: 25-6AV6, 40 6BA6, 15-12AU7, 25-12BA6, 70-12BD6; Grommes 251 deluxe sig. tracer; Sprague TO-3 Tel-Ohmike; Precision E-200-C sig. gen. Want tape recorders, tapes, decks, preamps, hi-fi equip. William Wallenbecker, 110 S. 19 Ave., Maywood, Ill.

FOR SALE — Hickok 650C video gen., includes color adapter, in perfect cond. and original carton, with manual and all leads, \$125. LeRoy Singer, 4 Atwood Rd., Plainville, L. I., N. Y.

FOR SALE — Ohmite reostat 1250 ohms 2 amps, \$5; GR variac V-2, \$8; Superior powerstat type 1126 15A, \$20; elect. design voltmeter, \$15; VU meter, \$15. Walter Zinsmeister, 146 N. 16 St., Bloomfield, N. J.

FOR SALE — RU-18 Navy aircraft-navigation rcvr, frequency 195-13, 575 kc. new converted to 117 VAC or vibrator usage, complete with spare tubes, shock mount, manual, \$23; BC-929 surplus scope converted, \$19; BC-453 superhet aircraft rcvr., frequency 195-550 kc, converted, \$12. Victor Wong, 430 Southview Ave., Cincinnati 19, Ohio.

FOR SALE — GE variable reluctance cartridge: RPX050, triple play with diamond and sapphire stylus. Hardly used, \$10 postpaid. Robert Price, 2337 Walton Ave., Bronx 68, N. Y.

FOR SALE — Zenith transoceanic, slightly used, \$75. J. Converse, 6523 Miller Rd., South Miami 55, Fla.

WANTED — General apparatus cross-over network No. 5 175 cycle, 16 ohm impedance inductor coils 10.2 M.H. William Fletcher, 115 Forest Ave., Riverside, Ill.

FOR SALE — Simpon 315 sig. gen., excellent cond., \$30. Send money order or will ship cod. Eugene Cheney, Box 308, Nora Springs, Iowa.

WANTED — Sine-square wave audio gen. Give all details and specifications in first letter. M. Emke, 4508 Broadway, Chicago 40, Ill.

WANTED — Sams in good cond. from set number 356 to 400. Will pay cash. Garvis McKeen, 109 Mallory Dr., La Grange, Ga.

FOR SALE — Triplett 221, 2 1/2" round, 0-5, 0-25, 0-100 DC ma, \$4.50 each; phone patch, \$5; 6 meter gear, xtal control conv., \$15; xmitter and mod., 10 w, \$15. E. J. Wolitzter, 2143 82 St., Brooklyn 14, N. Y.

WANTED — Knight FM tuner and Paco test equip. O. Zethmeier, 1123 Woodycrest Ave., New York 52, N. Y.

WANTED — 78, 45 and 33 1/3 overhead record cutter, with or without head, interested in all types: Presto Rek-O-Kut, Scully, etc. State price and cond., or have trading equip. Skippy Settle, Box 4121, Dallas 8, Tex.

SELL OR SWAP — Power transformers, fil. transformer, filter chokes for C-D ant. rotor. Sam Ottaviano, 1018 S. Main St., Medina, N. Y.

WANTED — Tape recorder in good cond. and used 12" or 16" TV. Will pay cash. Edwin L. Herman, 2479 Shirley Ave., Baltimore 15, Md.

FOR SALE — Back copies of Radio Electronics, Radio TV News and Aircraft Manuals. Complete list on request. Louis Porsetsky, 253 W. 24 St., Deer Park, L. I., N. Y.

WANTED — To buy, trade, or borrow: instructions and tube charts for Weston 777 tube checker. Joseph Eberson, 2116 Morris Ave., New York 53, N. Y.

FOR SALE — 50 1SM1 microswitches SPDT, and 128 WE 4D transistors, reasonable. Freedman, 3 Channel Dr., Great Neck, L. I., N. Y.

FOR SALE — Sylvania 500 sweep gen., and 501 marker; Hickok 600A tube checker. No reasonable offer refused. John H. Oxrieder, 7604 Elmore Lane., Bethesda 14, Md.

SWAP OR SELL — 3-xtal or magnetic recording heads, also recorders less amp. (Philco), 8 to 12 tube radio, sh. wave some FM, less cab., 35mm slide projector 200W single feed. Want sig. gen. test equip., etc. Olson, 5734 Waring, Los Angeles 38, Calif.

FOR SALE — Precision 10-20P combination tube tester multimeter; Heath V-7 VTVM, both 1. n.; Penoscilite. No reasonable offer refused. M. Rafayko, 180 Winston, Lexington, Ky.

FOR SALE — HQ 129X rcvr., \$100. Very good cond. R. E. Fairchild, Shore Dr., Guilford, Conn.

WANTED — SW-3 and/or coils. Robert Ellis, 7518 Merrill Ave., Chicago, Ill.

SELL OR TRADE — Superalloy Toroid cores for winding audio transformers, \$3.35 each or 3 for \$1 postpaid in the U.S. P. J. Martin, 520 Frederick St., Herrin, Ill.

FOR SALE — Ten Redmond BL172 blowers, double end. 115 v, 2300 rpm, 1A, 135 cu. ft. per min. Mailed prepaid in U.S. \$9.50 each. John A. DeFrees, Durhamville, N. Y.

FOR SALE — DX-100 xmitter, NC-2-40D National rcvr. with matching spkr. and handbooks, 40 mtr. half wave antenna. Relay switch, \$250. Will deliver free between Fla. and N. Y. around Xmas. Robert De Bate, 7280 S.W. 9th St., Miami, Fla.

WANTED — Diagram for Tele-King model KC-11. Greiner Radio & TV, 87 Eisenman Ave., Kenmore 17, N. Y.

WANTED — Heathkit ignition analyzer or instruction and list that come with kit. R. F. Meates, 72 Bocket St., Pearl River, N. Y.

BUY, BORROW, OR RENT — Service manual or complete alignment information for National NC 101X radio rcvr. Raymond Dodge, 676 Verde Vista Ave., Pomona, Calif.

WANTED — Schematics for Wilcox transmitter 96A, Supreme multimeter 542, surplus RT-93A/APN-11, freq. of UHF antenna AS-64/APGA. N. Contrucci, 5325 Main St., Williamsville 21, N. Y.

FOR SALE — VTVM, \$35; VOM, \$25; sig. gen., \$55; tube checker, \$45; wire rec., \$50; FM tuner, \$20; ham rcvr. with spkr., \$175; QST's 1933-1950. Cash or swap. John Pellock, 715 N. 7th, Benld, Ill.

WANTED — Elmac A-54 or AF67 xmitter, Johnson matchbox, coils for Globe Champion xmitter, 10-20-40 meters, Gonset 2 mtr. communicator. A. Haberman, 129 Morgan St., Holyoke, Mass.

SELL OR TRADE — RME-84 communications rcvr. 550kc-44mc, \$45; Super Pro rcvr. BC779, \$70; Mallory 6-volt vibra-pack, \$5; free list surplus schematics and tech manuals. S. Consalvo, 4905 Roanne Dr., Washington 21, D. C.

WANTED — Model marine steam engines and boiler, RC equip., telescope lenses, and a sextant. Have cash and test equip. to trade. Theodore Nadeje, 5101-AA 39 Ave., Sunnyside 4, N. Y.

WANTED — Do-All-RCP sig. gen.; Central Electronics rejuvenator; fluorescent sign television. Ken's TV Exchange, 30 Court St., Brockton, Mass.

FOR SALE — SX-88 rcvr., very good cond., best offer; SX-100 rcvr., 1. n., \$175. Bob Sturman, 2665 Harrington Dr., Decatur, Ga.

WANTED — Service manual and/or schematic for Capehart-Farnsworth AM-FM tuner No. 11D7-1. R. B. Vosk, 2300 Windsor Rd., Baldwin, L. I., N. Y.

FOR SALE — 1 to 84 Sam's manuals; 25% discount on old type tubes; Telohmike TO-3. All inquiries answered. C. L. Dennis, Walton, N. Y.

WANTED — Small all wave rcvr. for cash, Hallicrafter S-38 or similar; also borrow, rent, or buy schematic for BC-639 VHF rcvr. H. Marhoff, 1130 10th St. S., St. Petersburg, Fla.

WANTED — Sprague TO-4 Telohmike, must be low price, in repairable cond. J. Kozma, 12450 NW 5 Ave., Miami 68, Fla.

WANTED — BC-348Q with or without AC conversion. State price and cond. David L. Tanenbaum, 401 Kenmore Ave., Bel Air, Md.

FOR SALE — Rider's Radio manuals 6 to 13, \$45 plus cod. Stephen Barniak, 2426 Perot St., Philadelphia 30, Pa.

FOR SALE — B & W 1-kw linear amplifier. in original carton, complete with two new GL-813 tubes but minus power supply. First \$235 takes it fob. Joe V. Wright, Box 1158, Rockport, Texas

FOR SALE — Heath TV sweep sig. gen., TS-2; RCA audio sig. gen.; Dumont 3, scope. D. Pomis, 711 East 95 St., Brooklyn, N. Y.

WANTED — RCA Pict-O-Guide Vol. 1. D. Sullivan, 2303 Clarendon Rd., Brooklyn 26, N. Y.

FOR SALE — National SW-54 Ham and SWL rcvr., 1 yr. old, good cond., \$40. J. P. Budd, 4870 Roosevelt Blvd., Philadelphia 24, Pa.

SELL OR TRADE — A61A dummy antennas with 4 amp. RF meters and 100 mmid vacuum condensers, ARC5/T21's, various panel meters, power supply condensers and chokes, xmitting mica's. Trade right to close out. Ed Block, Grandview, Texas.

FOR SALE — Central Electronics Q multiplier, \$20; Heathkit GD-1B grid dip oscillator with coils for 350 kc to 250 mc, \$20. Both 1. n. Alvin G. Sydnor, 304 Lakeview Dr., Ridley Park, Pa.

WANTED — General Radio output transformer type 942 A. Will pay \$60 for transformer in good cond. William Chalmers, 441 Nevada St., Paramus, N. J.

WILL PAY — \$2 plus postage for used TV boosters. Send postage paid, will then mail money order. Radio-TV Sound Labs., 719 Doris, Biloxi, Miss.

FOR SALE — Handbook, 350 w, 6 meter xmitter, 6146 exciter, pair 811 modulator, 4-125A final, 3 power supplies. All rack mounted in two matching cabinets, as is \$250. Will not ship. Carl R. Willis, 464 Forest St., Mansfield, Ohio.

FOR SALE — Complete amateur station: 10-20 meter, 35 watts rcvr, NC-57 and VFO, \$85 to local hams; also Superior tube tester and 670A meter, both \$60. Frank Bou, 47 Oswego Ave., Audubon 6, N. J.

FOR SALE — Proceedings of the I.R.E., complete from January 1942 through December 1957, as mailed in perfect cond. Alex W. Levey, 1421 Lakeside Dr., Wantagh, N. Y.

WANTED — Radiola SW converter and AG-814 table-top loop, or similar; Radio-Art 210 rcvr.; cone speaker; short wave league literature; 81's and 99's. All replies acknowledged. Moore, 1485 Bush, San Francisco 9, Calif.

FOR SALE — Viking 1 phone CW xmitter, deTV'd, Bud low pass filter, Meissner sig. shifter, 829-B final, spare 829-B. Will demonstrate. \$150. J. Pyrry, 192 Norman Way, Paramus, N. J.

WANTED — Sam's Photofacts; sound system, AC gen.; walkie talkie; projector; VTOM tube tester; program time clock; tape recorder. Cash waiting. S. Kizak, 65 Main St., Pawtucket, R. I.

WANTED — Cabinet for Bendix 65P4U table model radio, ivory or brown, not cracked. Walter Inman, 8110 Summit, Kansas City 14, Mo.

FOR SALE — CIRE master course, leading to FCC first-class phone, first-class cond. with advanced TV training course. \$125. Shipped fob. Bart B. Bonney, 86 Pennsylvania Ave., c/o Mrs. W. W. Long, Coatesville, Pa.

FOR SALE — Precision E-400 sweep gen., \$65; RCP 740A sig. gen., \$45; Simpson Capacohmeter 383-A, \$45; Wintronix AGC analyzer, \$45. J. W. Patrick, 2906 Gilham St., Philadelphia 49, Pa.

FOR SALE — Perfect dyn. pri. 25 v sec. 540 v. @ 450 ma. vibrator supplies, misc. meters and parts. Write for list. Moffatt, 5707 Boca Raton Dr., Dallas 30, Texas.

SALE — Gonset 1. 2 m., \$100: includes carbon microphone, double ground plane, xtal and cable, for 110 v and 6 v. H. Lulli, 191-D Menlo Ave., Hawthorne, Calif.

WANTED — Heath QF-1 Q multiplier, state cond. and price. Edwin C. Eisenbeis, 2813 Sheila Dr., Louisville 5, Ky.

FOR SALE — Collins 32V1 with manual, 1. n., \$235 plus shipping charges. Will ship any part of U.S. Samuel Lieberman, 130-29 228 St., Laurelton 13, N. Y.

FOR SALE — Sam's Photofacts, excellent cond. Vols. 1 thru 15, \$12 each, 16 thru 36, \$15; good Gonset tri-band converter, \$25; 6 and 12 v dynamotors, \$10 each. Postpaid. Jack Johnson, Box 182, Delton, Mich.

FOR SALE — Mallory 12RS6D 6-12 v supply, \$32; Heath VTVM V6, \$20. Like new with manuals. L. F. Pettis, 3340 Harriet Ave., Minneapolis 8, Minn.

FOR SALE — Riders 1 to 21 Radio and 1 to 7 TV Service manuals inclusive, \$100 for all, good shape. Snyder TV & Hobbies, 972 Selma Rd., Springfield, Ohio.

FOR SALE — Alliance tenna rotor, \$10; Mallory UHF converter all channels, \$10 plus fob. L. W. McCollom, 8040 Frederick St., St. Louis 15, Mo.

WANTED — Converted SCR-522 model C rcvrs., guaranteed to cover 90 to 146 mc. AC powered, or other rcvrs. that will meet same specs. P. West, 201 Liberty St., Martinsburg, W. Va.

SWAP — TV remote control CM-34, for Eico P-P meter 232 or 249. Phil M. Benizzi, Sr., 1606 East 56 St., Brooklyn 34, N. Y.

WANTED — Any make all band rec., working order not important if real cheap. Dewitt White, Route 4, Toccoa, Ga.

SELL OR TRADE — Radio books and magazines from 1932 to present, good cond.; 25 w P.A. system with 2 horns and drivers; test equip. Edward J. Graf, Box 3930, Cleveland 20, Ohio.

SWAP — Perfect Westinghouse H564PA portable radio for TV-Radio course, books, good Garrard turn table, record changer. J. T. Wentworth, Box 1585, Mobile, Ala.

SELL OR TRADE — Unused 7BP7 Cathode Ray tube, in original carton, cheap or trade for what have you. George Gordon, 1945 Davidson Ave., Bronx 53, N. Y.

SELL OR TRADE — Radio-TV Sales and Service Shop, nice 5-room home in connection shop since '39. Population 3,000 close to Mt. Shasta Ski Bowl. Ed Cripps, Box 275, McCloud, Calif.

WANTED — Amateur radio communications rcvr., single or dual conversion, with or without speaker, in good working cond. State particulars and lowest prices acceptable. D. Landesberg, c/o Y.M.C.A., 179 Marcy Ave., Brooklyn 11, N. Y.

FOR SALE — Good cond. Bell RC-47A 3-speed disc recorder, player and PA system combination, \$60 plus express charges. Send money order. Edward Obarowski, 30 Knoll St., Waterbury 5, Conn.

FOR SALE — Paco G-30-PC RF sig. gen., factory wired and calibrated, tuning head to 1% accuracy, with audio test leads, \$35; Superior TV 40 picture tube tester in perfect cond., \$12.50. E. Giroux, 735 Park Ave., Hoboken, N. J.

FOR SALE — L. n. Knight wide-band scope and probes, \$50; 8AXP4 TV check tube, \$12; Precision E-200 sig. gen., \$30; Solar CE capacitor analyzer, \$25; Precision 920 transconductance tube tester, \$30. Dave Stroup, E 2428 Everett, Spokane 28, Wash.

SELL OR SWAP — Simpson 488 field strength meter, \$35; Webster 3-speed changer, \$10; VM hi fi 4-speed changer Ronette cartridge, \$25; Heath FM tuner AFC added, \$25. All plus postage. Want tape recorder or hi-fi gear. A. Consiglio, 49 Wallace Place, White Plains, N. Y.

FOR SALE — Hickok 610A TV-FM alignment gen., 0-115 mc and 150-230 mc, 60 cycle sweep, 400 cycle modulation, external 4.5 mc xtd, instruction book, perfect, \$65 prepaid. Gene Rider, 1810 Alamanda Dr., N. Miami, Fla.

FOR SALE — Transmitter Heathkit DX20 good cond., \$40. J. A. Hagstrom, 1327 Leonard St., Muskegon, Mich.

WANTED — Radio TV course. State all in first letter. F. Reger, 121 So. Brandywine Ave., Schenectady 7, N. Y.

FOR SALE — Precision E-200C sig. gen. Perfect cond., \$40. Ernest Michailoff, 32 Plymouth Ave., Johnstown, Pa.

FOR SALE — Custom built radio, short wave, recorder, and single speed phono combination, in a walnut mahogany cabinet. Ideal for hi-fi or stereophonic conversation, \$75. D. M. Masi, 54 Lake St., Belleville, N. J.

SELL OR TRADE — Riders and Sams manuals, BC-625 xmitters, 832A tubes. Need 813 and 304 TL tubes, RCA surplus 500 w mod. trans. E. L. Felder, Box 148, Tylertown, Miss.

FOR SALE — Rider Radio manuals 1-16 — Vol. 1-6 used but clean, others perfect cond. Make offer. Suburban Radio, 33 Tilley Ave., Pompton Plains, N. J.

FOR SALE — Gonset 10-11 converter, \$10. C. F. Bale, 9 Simonson Pl., Staten Island 2, N. Y.

FOR SALE — VM 714 tape recorder, stereo playback, purchased April, 1958, 1. n., complete with accessories and 22 rolls tape, \$140; mahogany base for RC-88, \$3. Local only. H. Allen Johnson, 8218 10th Ave., Brooklyn 28, N. Y.

FOR SALE — Heathkit scope 0-8 with manual A1, \$25; Sam's Photofacts Vols. 1, 2, 3 with binders, \$15 for all. Mac's Radio & TV, 116 W. Broad St., Linden, Mich.

FOR SALE — SCR 522 two meter xmitter, \$15; rcvr, \$10; ARC-4 two meter transmitter and rcvr., \$15; all with tubes; APS-13 less tubes, \$4; 829B, \$5; 4-65A, \$6. E. P. Sadler, 398 Sigourney St., Hartford, Conn.

WANTED — Bargain in Sherwood, Scott or Eico FM tuner, used or shopworn, for cash. M. M. Odil, 1005 Princeton, Kalamazoo, Mich.

WANTED — Will buy or rent instruction book or alignment data for Karl Pierson KP-81 communications rcvr. V. Barker, Woodside Dr., Freeport, Ill.

WANTED — Operating manual and wiring diagram of CF solar exam-eter condenser checker serial F94069. Advise price. M. S. Windham, 3305 Roberts Cutoff, Ft. Worth 14, Tex.

WANTED — Instruction book and/or schematic diagram for HRO. P. Polton, 3702 E. Oakwood, So. Milwaukee, Wis.

FOR SALE — Sylvania 7" scope type 400, excellent cond., with probes, peak to peak comparison meter, 4 extra tubes, less than half cost, \$140. Local only. Christopher Haug, 780 Edward St., Baldwin, N. Y.

FOR SALE — Complete TV workshop including Sams, test equip — mostly Heath, tubes, parts, resistors, condensers, tube caddy, etc. Prefer local sale. Howard P. Grant, 26 Guild Rd., Beverly, Mass.

WANTED — Meter magnet charger. High current type using condenser discharge system. Give price, cond., and type. Anthony Lavitola, 75 Colgate St., Jersey City 2, N. J.

WANTED — Matchbox, Johnson or equivalent. M. S. Nourse, 601 Milverton Rd., Los Altos, Calif.

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